Stanislaus River Fall Chinook Salmon Escapement Survey 2005

Prepared By

Jason Guignard
Biologist (Marine/Fisheries)
California Department of Fish and Game

For
United States Bureau of Reclamation
Contract # R0540004

April 2006

Introduction

San Joaquin River fall-run chinook salmon are currently a candidate species under the Federal Endangered Species Act. Population levels in the Stanislaus River, a tributary to the San Joaquin River, have declined in the past 50 years from approximately 35,000 returning adults in 1953 to a low of 160 in 1996 (Heyne, 2000). Escapement estimates for the past 5 years have ranged from a low of approximately 3,150 in 1998 to a high of approximately 8,500 in 2000 (Marston et al., 2002). The decline of the species can be attributed to many factors. In general, reduction of spawning and rearing habitat and stream flow management practices, are thought to be major factors limiting overall population numbers. Numerous additional factors including but not limited to predation, streambed alteration, pump diversions, gravel mining, land use practices, and ocean angler harvest contribute to a web of complex population dynamics which effect population numbers within the habitat currently available to Stanislaus River chinook salmon.

The California Department of Fish and Game (CDFG) has conducted escapement surveys on the Stanislaus River since 1953. The Schaefer mark recapture escapement estimation model (1951) has been utilized since 1971. Philip Law (1994) determined the Jolly-Seber model (1973) yielded a more accurate population estimate over all variable ranges when compared with the Schaefer model. The 2005 escapement survey was analyzed using both the Jolly-Seber and Schaefer models. Additionally, the 2002 through 2005 Stanislaus River escapement data was analyzed with POPAN-5 (Arnason et al., 1998). POPAN-5 is a custom software program developed for the analysis of mark-recapture data.

The current objectives of the Stanislaus River escapement surveys are:

- Estimate the escapement of fall-run chinook salmon on the Stanislaus River.
- Evaluate the distribution of salmon redds throughout the study area.
- Collect fork-length and sex data.
- Collect scale and otolith samples with which to conduct age determination and subsequent cohort analysis.
- Collect and analyze coded wire tag data from marked hatchery fish to determine escapement contribution of hatchery produced salmon, and evaluate smolt survival.

Study Area

The 2005 Stanislaus River escapement survey covered a 25-mile reach beginning at river mile (RM) 58, and continuing downstream to Riverbank (RM 33) (Figure 1). The survey is divided up into four sections, with section 1 being the upstream most reach. Section 1 begins below Goodwin Dam (RM 58) and extends downstream to Knight's Ferry (RM 55) and includes riffles A1 thru C2. Section 2 begins at Knight's Ferry (RM 55) and continues downstream to Horseshoe Road Recreation Area (RM 50.5) and includes riffles

E1 thru J2. Section 3 begins at Horseshoe Road Recreation Area (RM 50.5) and continues downstream to the Oakdale Recreation Area (RM 39.5) and includes riffles J3 thru T4. Section 4 begins at the Oakdale Recreation Area (RM 39.5) and continues downstream to Jacob Myers Park (RM 33) and includes riffles U1 thru Z2.

All riffles in the study area have been geo-referenced using a Trimble GPS TDC1 and mapped with the GIS computer program Arc View. In 2001, each riffle within the entire four section spawning reach was systematically re-named using sequential letter/number designations for river mile and riffle respectively. For example, the first riffle immediately below Goodwin Dam is named A1. Each letter designates a different river mile length (riffle A= RM 58, riffle B= RM 57 etc.). This numbering system is a departure from the historical riffle numbering system. However, the new riffle identification system is more logical and is more conducive to editing as river morphology changes.

In 2005, each riffle within the study reach was mapped prior to the spawning season. These updated riffle numbers, and river mile, are located in Table 1 and are cross-referenced with the 2004 riffle numbers. Riffle cross-reference for the historical cross-referencing system can be found in the 2001 and 2002 Stanislaus River escapement reports

Methods

Population Estimation

Both the Schaefer (1951) and Jolly-Seber (1973) mark-recapture method were used to estimate fall-run escapement on the Stanislaus River. Under this scheme, carcasses are marked and subsequently recovered during weekly surveys of the spawning reach. A ratio of recoveries to total fish counted (handled) is used to calculate weekly population estimates, which are then summed to estimate the total spawning population. Total fish counted (handled) includes total fish tagged, skeletons, and fresh recoveries by week. The CDFG survey began on September 26, 2005 (Week 1) and concluded on December 22, 2005 (Week 13). Carcasses were tagged for the first 12 weeks and week 13 was limited to the recovery of carcasses. During the recovery week (week 13), carcasses were collected, examined for jaw tags and chopped in half. During this period, all untagged fish were chopped and counted as skeletons.

Weekly drift boat surveys were conducted in sections 2, 3, and 4 using a three person crew. All visible carcasses were collected from each riffle and the pool immediately below. Multiple passes were made through each pool to ensure that the entire area of that pool was examined. Every carcass handled was designated as fresh, decayed, skeleton, or recovery depending on the degree of decomposition or the presence of an aluminum jaw tag in the case of recoveries. The fresh carcass designation criteria during 2005 were at least one clear eye and the presence of blood remaining in the gills (Figures 2 and 3). Decayed fish had cloudy eyes and no blood in the gills. Skeletons were fish judged to be in an advanced state of decay and unlikely to have the same probability of recapture as fresh and decayed specimens. Criteria for skeleton designation during the 2005 survey

included the presence of fungus covering the entire body at the freshest end of the skeleton designation (approximately one week) to actual skeleton at the most decayed end (Figure 4 and 5).

All fresh and decayed carcasses were given a unique number by attaching an aluminum head tag to the lower jaw. These newly tagged carcasses were redistributed to river current near the lower end of the riffle for recovery in subsequent weeks. For tagged recoveries, the unique tag number was noted and the carcass was chopped and returned to the river. All skeletons were enumerated, chopped and returned to the river to avoid double counting.

Section 1 is too dangerous to float by drift boat, therefore this section was surveyed by foot and consisted of a 2 person crew walking to accessible pool and riffle combination areas where carcasses are known to aggregate based upon previous carcass surveys. Retrieved carcasses were enumerated, chopped, and released back into the water to avoid duplicate counting. No effort to conduct a tagged capture/recapture (i.e., Schaefer etc.) survey was initiated. The escapement population estimate for Section 1 consisted of calculating a divisor comprised of the ratio of retrieved tagged carcasses to the total number of carcasses tagged in Sections 2, 3, and 4 (i.e., to determine visible fraction of total carcasses present), then dividing the actual number of fish handled in Section 1 by this divisor.

Weekly Fish Distribution and Redd Counts

Weekly live fish observations and redd counts were conducted during the survey. These counts were conducted for each riffle and pool using the riffle identification system noted earlier. Counts were made using tally counters as the field crews drifted through riffles and pools. Live and redd counts were conducted through the entire fourteen week escapement survey period.

Individual Fish Data Collection

Fork length (to the nearest 0.5 centimeter) and sex data are collected for all tagged carcasses. Scale samples and otoliths are collected from a percentage of specimens to determine the size and age composition of annual spawning runs. Coded wire tag's (CWT) were collected from hatchery produced (adipose fin clipped) carcasses returning to the Stanislaus River as part of long term survival testing releases of marked outmigrating smolts and to determine incidence of straying from other river systems. CWT specimens are also used to validate scale and otolith age determination work.

Scale samples were collected from both wild and CWT carcasses and are catalogued at the CDFG La Grange Field Office. Coded wire tags and otoliths are collected via removal of the head minus the lower jaw with field tag attached. Extraction and analysis of otoliths and CWT's is conducted by CDFG staff after the spawning season. All fish samples are catalogued by the fish's unique jaw tag number, which allows the samples to be tracked to the specific date and riffle number of collection.

Additionally, in 2005 female carcasses were examined to determine the occurance of any pre-spawn mortality. All fresh female carcasses were cut open and examined for the presence of remaining eggs. Carcasses were classified as fully spawned, partially spawned, or unspawned.

Results

Escapement Estimate

In Sections 2, 3, and 4 a total of 340 carcasses were tagged during the 2005 Stanislaus River escapement survey. An additional 232 skeletons were tallied and chopped giving a total of 572 individual chinook salmon handled during the escapement survey. One hundred and forty-one tagged carcasses were recovered for an overall 41.5 % tagged carcass recovery rate. Based on the Schaefer model, using all tagged fish, the 2005 escapement estimate for sections 2 through 4 is 3,050 salmon. The Jolly-Seber model yielded an estimate of 1,025 for sections 2 through 4. Both models utilize the number of recoveries of tagged carcasses, the total number of tagged fish and the total number of carcasses handled each week (Table 2) to generate weekly escapement estimates. The total numbers of carcasses tagged each week and the number of recoveries made in subsequent weeks in relation to tag week are shown in Table 3.

In Section 1, carcasses were not recovered so the Schaefer and Jolly-Seber models could not be used to generate an estimate. For this section, a simple expansion estimate was made based on the number of fish handled (110 fish) and the recovery rate for the lower sections (41.5%). The resulting estimate was 265 fish in Section 1. Combining the Schaefer estimate for Sections 2 through 4, using all tagged fish, with the Section 1 estimate yields a grand total of **3,315** fall-run chinook salmon spawning in the Stanislaus River in 2005.

Live Salmon, Redd, and Carcass Counts

Weekly live fish observations increased steadily and peaked in week 7, with 749 live fish being observed, then sharply declined after week 9. Redd counts peaked in week 9 with a high of 816 redds counted (Table 4 and Figure 6). The number of live fish, redds, and tagged carcasses observed by week are graphed in Figure 7. The maximum number of redds counted for individual riffles is presented in Table 5. The highest concentration of spawning (100 redds per river mile) occurred within Section 2. Sections 1 and 3 had approximately 74 and 31 redds per river mile respectively, and Section 4 had 12 redds per mile (Figure 8).

Population Composition

Coded wire tagged fish comprised 4% of the total tagged carcasses based on the ratio of adipose clipped fish to total tagged carcasses (Table 2). Skeletons were not checked for adipose fin clips due to their advanced state of decomposition. However, it is likely that ratios calculated for tagged fish are representative for skeletons as well. The total contributions (tagged fish only) to the spawning population were 30% for natural males, 2% for CWT males, 66% for natural females, and 2% for CWT females (Figure 9).

A total of 18 heads were collected from adipose fin clipped fish during the escapement survey, CWTs were found in 13 of these heads. CWT verification and tag reading showed that 61% of CWT fish were Merced River Hatchery orgin; with 38.9% being VAMP study fish, 16.7% Stanislaus Survival, and 5.6% Tuolumne Survival. The remaining 11% were Mokelumne River orgin, and 27.8% had no tag present. The percentage of fish with no tag present was much higher than in previous years. It is believed that some of these fish were not adipose fin clipped, but were collected due to erosions in the adipose area. Appendix 1 shows the results of all CWTs that were recovered on the Stanislaus River during the 2005 study period.

Length frequency histograms of male and female display bimodal peaks (Figures 10 and 11). The first peaks are likely grilse (age 1 and 2) and the second peaks are likely adults (age 3, 4, and 5). Because the histograms display overlap between age groups, separation of cohorts will be determined upon completion of age determination studies (CWT, scale, and otolith analysis).

Based on the San Joaquin River Basin length frequency histograms, the 2005 breakpoint between grilse and adults were 71 cm for males and 64 cm for females. Grilse accounted for 7% of the total tagged fish. This is down from 2004, when 30% of the tagged fish were grilse. Grilse composition for CWT fish was not determined due to low CWT recaptures for the entire basin.

Sample Collection

Scales and otolith samples were collected from both natural and adipose fin clipped fish throughout the survey period and survey area (Tables 6 and 7). Distribution of sampling is intended to best represent the spawning population over time, space, and origin. Scale and otolith samples will be utilized in the CDFG age determination program and for subsequent cohort analysis of the San Joaquin River Basin chinook salmon populations.

Pre-Spawn Mortality Evaluation

A total of 250 fresh female carcasses were examined in order to determine the level of pre-spawn mortality in the Stanislaus River. A total of 1 fish was found to be partially spawned, and 4 fish were classified as unspawned. This represents 2% of examined fish that were not fully spawned.

Egg Production Estimation

An estimate for the number of eggs produced by the 2005 fall run was generated using a standard regression equation (158.45 * fork length cm – 6138.91= number of eggs). This fork length-fecundity relationship was determined for 48 San Joaquin fall-run chinook salmon females ranging from 62.5 to 94.0 cm fork length (Loudermilk et al. 1990). In the 2005 Stanislaus River escapement survey, the number of eggs was calculated for the expanded natural (n=2188) and CWT (n=66) female population, based on the Schaefer estimate. The number of natural female carcasses collected was 295 with an average egg production of 5,808 eggs per female. The number of CWT female carcasses collected was 10 with an average egg production of 5,444 eggs per female. Expanding the total egg production for the Stanislaus River in 2005 using the egg production regression

equation yields a total of 13,068,727 eggs based on the Schaefer population estimate, with 12,707,805 produced by natural females and 360,923 produced by CWT females.

Stanislaus River Flows

Stanislaus River flows for the period of October 1, 2005 through January 15, 2006 are shown in Figure 12 (preliminary data obtained from the California Data Exchange Center). River flows recorded at Orange Blossom Bridge (OBB) and Goodwin Dam (GDW) are reported, because the OBB gauge does not accurately record high flow events. A pulse flow (attraction flow) was initiated on October 18, for ten days with a maximum flow of approximately 1000 cubic feet per second (cfs) released over Goodwin Dam. The purpose of fall pulse flows, occurring in the Stanislaus and other San Joaquin River tributaries is threefold: 1) attract salmon into the Stanislaus River from the San Joaquin River; 2) cool water temperatures in the lower reaches of both the Stanislaus and San Joaquin River; and 3) improve oxygen conditions in the Stockton Deep Water Ship Channel. Spawning period flows in the Stanislaus River, OBB gauge, averaged 350 cfs from November 1, 2005 through December 15, 2005. On December 15, flows increased sharply to a high of 6500 cfs due to flood control releases from New Melones.

Stanislaus River Temperature

Water temperature in the Stanislaus River was recorded at several locations in 2005. Water temperatures are monitored at various locations within the New Melones Reservoir Complex (i.e., Melones, Tulloch, and Goodwin), as well as in seven locations within the lower Stanislaus River between Goodwin Dam and the confluence with the San Joaquin River. In-river water temperature data is recorded on an hourly basis and the average daily water temperature for three stations (Knights Ferry, Orange Blossom Bridge, and Riverbank) are presented in Figure 13.

Discussion

Population Estimate

The 2005 Stanislaus River escapement Schaefer estimate using all tagged fish was 3,315. This is down from the 2004 estimate of 4,068 (Guignard, 2005). In 2004 and 2005 the Schaefer estimates were used instead of the Jolly-Seber estimates. This is because in both years there were weeks of low counts for both marks and recoveries. Schwarz (1993) showed that the Jolly-Seber model is biased when counts are low (<10) for marks or recoveries, and it under-estimates with these conditions.

River conditions and water clarity were ideal for carcass recovery, live counts, and redd counts until December 15, 2005 (week 12) when flows increased greatly due to flood control releases from New Melones reservoir. These flows were too high to continue the survey, so the monitoring effort was stopped two weeks early. At the time that the survey was stopped, there was still spawning activity occurring and new fish moving into the system. We will not attempt to estimate the number of fish that spawned after the survey period, but based on previous estimates the final two week generally account for 2- 5% of the spawning population.

The Section 1 expansion estimate is most likely a very conservative estimate. The reason for this is threefold: 1) This section has a much higher gradient than the rest of the river, with a series of runs and deep pools, causing the carcasses to drift further and most likely fall out in the deep pools. 2) Only carcasses that "fall-out" near the shore are accessible, carcasses away from the edges are often unrecoverable due to the dangerous currents. 3) The steep canyon topography makes much of this section inaccessible, thus some spawning areas are not surveyed. It is recommended that further analysis be done on this section in order to obtain a more accurate estimate.

Table 8 shows the 2002 through 2005 population estimates for the Stanislaus River based on the three population models; Schaefer, Jolly-Seber, and POPAN Jolly-Seber. These estimates are not for the entire river, only Sections 2, 3, and 4, because Section 1 does not support the mark-recapture methodology. The POPAN Jolly-Seber model is the preferred model, because it includes confidence intervals around the estimate.

Spawning Distribution

Redd counts are strongly affected by time of day, visibility, sunlight, wind rippling the water surface, redd superimposition, and other physical factors as well as the natural variability between observers. Furthermore, redd counts are conducted with a single pass as opposed to an intensive systematic approach beyond the scope of this study. In the primary spawning riffles of Section 1 and 2 the problem of redd superimposition is acute and leads to undercounting. On the other hand, redds further down the river are easily delineated as clean patches of freshly worked gravel among patches of darker undisturbed gravel. In these sections redd counts are accurate indicators of spawning density. For these reasons, the disparity between spawning density is likely greater than displayed in Figure 8. River miles 57 and 55 show no spawning activity because these sections of the Goodwin Canyon reach were not surveyed.

Population Composition

Figures 10 and 11 show the length frequency histograms of all male and female Chinook salmon examined in the Stanislaus River respectively. The red line on these figures represent the breakpoints between age 2 and age 3 fish, this breakpoint is based on the forklengths of all fish examined in the SJR Basin in 2005. CWT fish were not analyzed separately due to the low number of adipose fin-clipped fish that were encountered. The CWT contribution to the spawning population was estimated to be 2% (n= 8) male and 2% (n= 10) female. This is lower than the 2004 estimate of 5% male CWT and 3% female CWT. A total of 155 scale samples were collected during the survey, an additional 303 scale samples were collected from live fish handled at the weir in Riverbank by S. P. Cramer staff. These scales are currently being analyzed by CDFG staff and an age determination report will be available in the near future.

Pre-Spawn Mortality Evaluation

A total of 250 fresh female carcasses were examined in order to determine the level of pre-spawn mortality in the Stanislaus River. Of these examined carcasses, only 2% were found that were not fully spawned. This represents a decrease from 2004 rate of 4.5%

partial or unspawned. Once again, the pre-spawn mortality levels on the Stanislaus River were very low this year and it is not seen as a major factor effecting the spawning population.

Stanislaus River Temperatures

Stanislaus River water temperatures remained above 13 C for most of October in the lower areas of the spawning reach (e.g., sections 3 and 4) as shown in Figure 13. With the fall pulse flow event, temperatures in the lower reach dropped to a suitable temperature. Spawning activity began to proliferate concurrent with water temperature cooling.

Table 1. Riffle Identification cross-reference for 2005 (New ID) and 2004 (Old ID). The corresponding river mile is noted next to the new riffle ID.

Section 1[a]		Section 2[b]		Section 3[c]				Section 4[d]	
New ID (RM)	Old ID	New ID (RM)	Old ID	New ID (RM)	Old ID	New ID (RM)	Old ID	New ID (RM)	Old ID
A1N (58.3)	A1N	E1 (54.5)	E1	J3 (50.5)	J3	O2 (45.8)	O2	U1 (39.1)	U1
A1S** (58.3)	A1S	E2 (54.3)	E2	J4 (50.2)	J4	O3 (45.6)	O3	V1 (38.7)	V1
A2 (58.2)	A2	E3 (54.2)	E3	K1 (49.7)	K1	O4 (45.5)	O4	V2 (38.5)	
A3 (58.1)	A3	E4 (54.0)		K1s** (49.6)	K1s	O5 (45.4)	O4	V3 (38.4)	V2
A4 (58.1)	A4	F1 (53.9)	F1	K2 (49.6)	K2	O6 (45.1)	O5	V4 (38.3)	V2
B1 (57.9)	B1	F2 (53.8)	F1	K3 (49.5)	K3	P1 (44.8)	P1	V5 (38.2)	V3
C1 (56.9)	C1	F3 (53.7)	F1	K4 (49.4)	K4	P2 (44.6)	P2	W1 (37.6)	W1
C2 (56.8)	C2	F4 (53.5)	F1	K5 (49.3)	K5	P3 (44.5)	P3	W2 (37.5)	W2
		F5 (53.5)	F2	K6 (49.2)	K6	P4 (44.0)	P4	W3 (37.3)	W3
		F6S (53.2)	F3S	K7 (49.0)	K6	Q1 (43.8)	Q1	W4 (37.1)	W4
		F6N** (53.2)	F3N	L1 (48.9)	L1A	Q2 (43.6)	Q2	X1 (36.7)	
		F7 (53.1)	F4	L2 (48.7)	L1A	Q3 (43.5)	Q3	X2 (36.6)	
		G1 (52.9)	G1	L3 (48.6)	L2	Q4 (43.3)	Q4	X3 (36.1)	
		G2 (52.8)	G2	L4 (48.3)		Q5 (43.1)	Q5	X4 (36.1)	X1
		G3 (52.6)	G3	L5 (48.2)	L3	Q6 (43.0)	Q5	Y1 (35.8)	Y1
		G4 (52.5)	G4	M1 (47.9)		R1 (43.0)	R1	Y2 (35.7)	Y1
		G5 (52.4)	G5	M2 (47.8)	M1	R2 (42.9)	R1	Y3 (35.5)	Y2
		G6 (52.3)	G6	M3 (47.4)	M2	R3 (42.1)	R2	Z1 (34.6)	Z1
		G7 (52.1)	G7	M4 (47.3)	M3	S1 (42.0)	R2	Z2 (34.2)	Z2
		G8 (52.0)	G7	M5 (47.1)	M4	S2 (41.7)	S1	ZA1 (33.9)	
		H1 (51.9)	H1	N1 (46.9)	N1	T1 (40.8)			
		H2** (51.8)	H2	N2 (46.6)	N2	T2 (40.6)	T1		
		H3 (51.6)	H3	N3 (46.5)	N3	T3 (40.5)	T2		
		H4 (51.5)	H4	N4 (46.3)	N4	T4 (40.4)	T3		
		H5** (51.5)	H5	N5 (46.1)	N5	T5 (40.2)	T4		
		H6 (51.4)	H6	O1 (45.9)	O1				
		H7 (51.2)	H7						
		H8 (51.1)	H7						
		J1 (50.9)	J1						
		J2 (50.8)	J2						

[a] Includes reach from Goodwin Dam to Knight's Ferry

[b] Includes reach from Knight's Ferry to Horseshoe Road Recreation Area

[c] Includes reach from Horseshoe Road Recreation Area to Oakdale Recreation Area

[d] Includes reach from Oakdale Recreation Area to Jacob Meyers Park

** Side channels surveyed during 2005 survey

Table 2. Weekly totals (does not include Section I).

Week	Total Tagged	Skeletons	Recoveries	Total Counted*	CWT's
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	2	5	0	7	0
7	31	12	6	49	1
8	61	21	27	109	3
9	69	54	24	147	4
10	66	36	35	137	4
11	71	41	47	159	3
12	40	61	2	103	3
13	0	0	0	0	0
14	0	0	0	0	0
Grand Total	**340**	**230**	**141**	**711**	**18**

*Includes total tagged, skeletons, and recoveries

Table 3. Schaefer distribution of mark week versus recovery week, number of tags recovered per week with survey totals. (Does not include Section I)

Recovery Week	Tag Week							Number of Tags Recovered	Total Carcasses Handled	Weekly Escapement Estimate
	6	7	8	9	10	11	12			
7	1							1	7	0
8		6						6	49	213
9		5	22					24	109	258
10		1	3	20				24	147	370
11			4	5	26			35	137	247
12				4	13	30		47	159	240
13							2	2	103	2060
Recoveries per Tag Week	1	12	29	29	39	30	2	**Overall Recovery Rate**		**Total Escapement Estimate**
Tagged Carcasses	2	31	61	69	66	71	40			
Recovery Percentage per Tag Week	50.0	38.7	47.5	42.0	59.1	42.3	5.0	**41.5 %**		**3,050**

Table 4. Total live fish, redds and carcass counts by survey week.

Week	Lives	Redds	Carcasses [a]
1	5	0	0
2	11	1	0
3	5	2	0
4	17	9	0
5	160	75	0
6	433	405	7
7	749	502	50
8	727	740	96
9	627	816	149
10	429	758	128
11	236	623	133
12	144	549	117
13	17	109	2
14	3	12	0
Total	**3563**	**4601**	**682**

[a] Carcasses includes all tagged carcasses and skeletons but does not include recoveries

Table 5. Maximum redd count for each riffle over the course of the escapement survey by section.

Section 1		Section 2		Section 3				Section 4	
Riffles	**Maximum # of redds**	**Riffles**	**Maximum # of redds**	**Riffles**	**Maximum # of redds**	**Riffles**	**Maximum # of redds**	**Riffles**	**Maximum # of redds**
A1N	24	E1	24	J3	6	O2	0	U1	6
A1S	24	E2	44	J4	6	O3	1	V1	3
A2	5	E3	31	K1	5	O4	3	V2	3
A3	12	E4	19	K1S	1	O5	7	V3	7
A4U	10	F1	11	K2	7	O6	6	V4	6
A4N	23	F2	11	K3	9	P1	4	V5	1
A4S	19	F3	13	K4	10	P2	6	W1	9
B1	7	F4	4	K5	10	P3	12	W2	3
C1	26	F5	17	K6	12	P4	2	W3	0
C2	45	F6N	3	K7	16	Q1	2	W4	5
		F6S	8	L1	14	Q2	7	X1	2
		F7	9	L2	4	Q3	6	X2	2
		G1	30	L3	3	Q4	0	X3	1
		G2	9	L4	3	Q5	4	X4	7
		G3	32	L5	4	Q6	5	Y1	3
		G4	14	M1	7	R1	8	Y2	3
		G5	12	M2	8	R2	5	Y3	4
		G6	6	M3	21	R3	6	Z1	2
		G7	27	M4	19	S1	2	Z2	1
		G8	15	M5	7	S2	3	ZA1	2
		H1	29	N1	12	T1	7		
		H2	0	N2	7	T2	2		
		H3	13	N3	5	T3	3		
		H4	8	N4	6	T4	6		
		H5	15	N5	5	T5	6		
		H6	11	O1	3				
		H7	12						
		H8	6						
		J1	7						
		J2	9						
Subtotals	195		449			323			70
Total Redds					1037				

Table 6. Distribution of scale samples collected by section and week from natural salmon. Adipose fin clipped salmon (cwt's) are noted in parenthesis.

Week	Section				Weekly Totals
	1	2	3	4	
1	0	0	0	0	**0**
2	0	0	0	0	**0**
3	0	0	0	0	**0**
4	0	0	0	0	**0**
5	0	0	0	0	**0**
6	0	0	2	0	**2**
7	3	5 (1)	7	1	**17**
8	0	14 (1)	8	0	**23**
9	8 (3)	17 (1)	11	0	**40**
10	5	12 (2)	6	0	**25**
11	0	16 (1)	12 (1)	0	**30**
12	5	7 (1)	4 (1)	0	**18**
Section Totals	**21 (3)**	**71 (7)**	**50 (2)**	**1**	**155**

Table 7. Distribution of heads collected by section and week from natural salmon. Adipose fin clipped salmon (cwt's) are noted in parenthesis.

Week	Section				Weekly Totals
	1	2	3	4	
1	0	0	0	0	**0**
2	0	0	0	0	**0**
3	0	0	0	0	**0**
4	0	0	0	0	**0**
5	0	0	0	0	**0**
6	0	0	2	0	**2**
7	3	2 (1)	6	1	**13**
8	0 (2)	7 (1)	6	0	**16**
9	0 (3)	7 (1)	11	0	**22**
10	0	2 (4)	4	0	**9**
11	2	16 (2)	10 (1)	0	**31**
12	3	6 (1)	3 (2)	0	**15**
Section Totals	**8 (5)**	**40 (10)**	**41 (3)**	**1**	**108**

Table 8. 2002- 2005 Schaefer and Jolly-Seber population estimates (Does not include estimate for Section 1). The numbers in bold represent the estimates that were reported in previous reports.

Year	Schaefer	Jolly-Seber	POPAN Jolly-Seber
2002	6960	**5533**	5710 ± 626
2003	6980	**5141**	5836 ± 697
2004	**3458**	2787	2813 ± 337
2005	**3050**	1025	950 ± 200

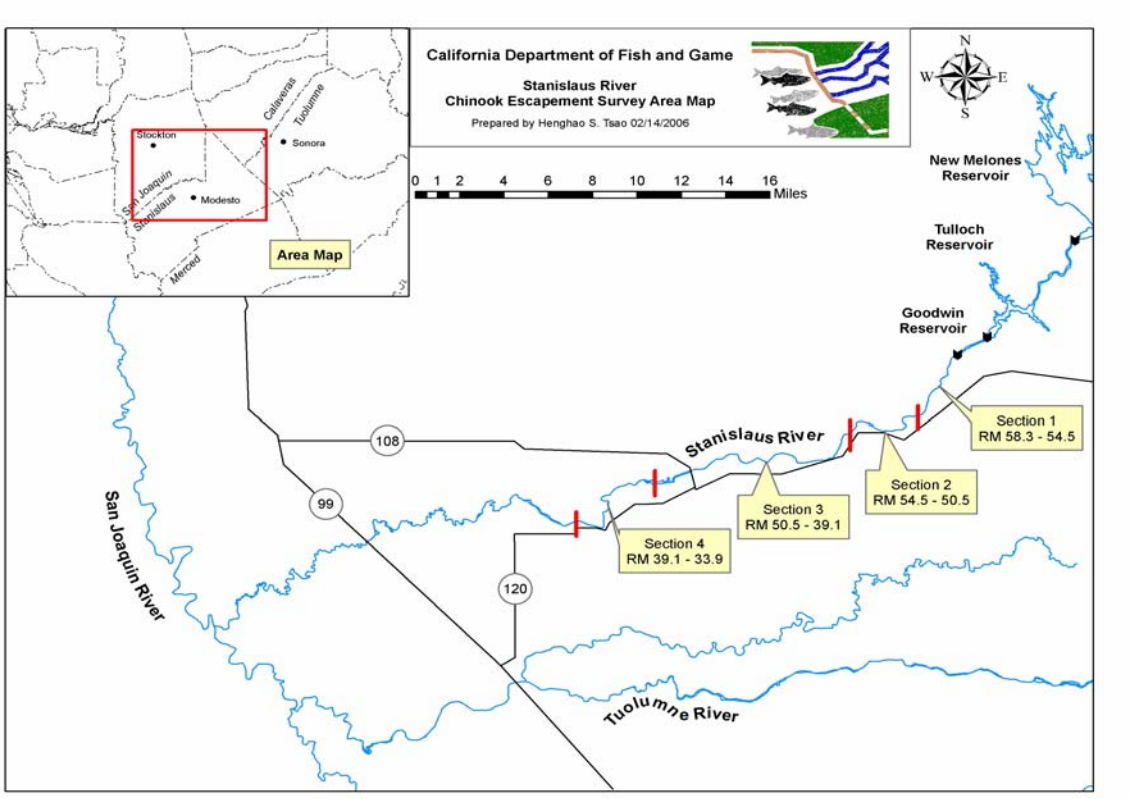

Figure 1. Map of Project Area.

Figure 2. Fresh carcass indicated by clear eye.

Figure 3. Fresh carcass indicated by presence of blood remaining in gill.

Figure 4. Fungus covered skeleton.

Figure 5. Two skeletons showing varied degrees of decomposition and a fresh carcass.

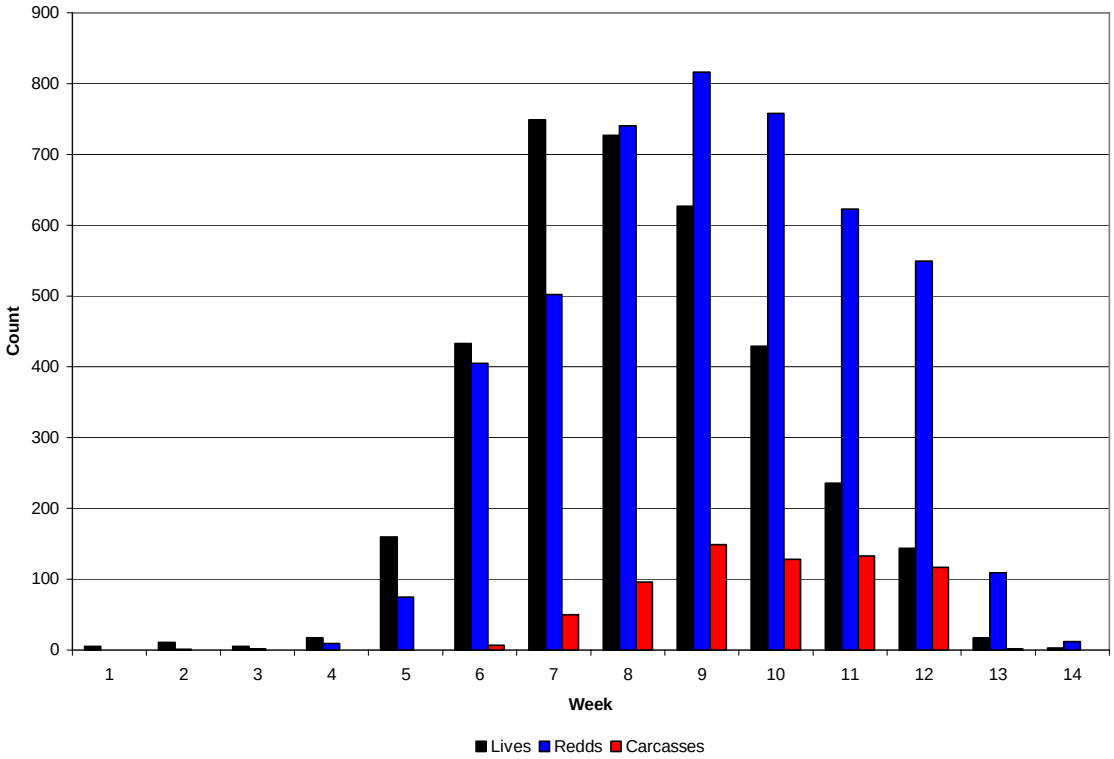

Figure 6. Live fish observation, redd, and total carcass weekly counts. Total carcasses includes all tagged carcasses and skeletons.

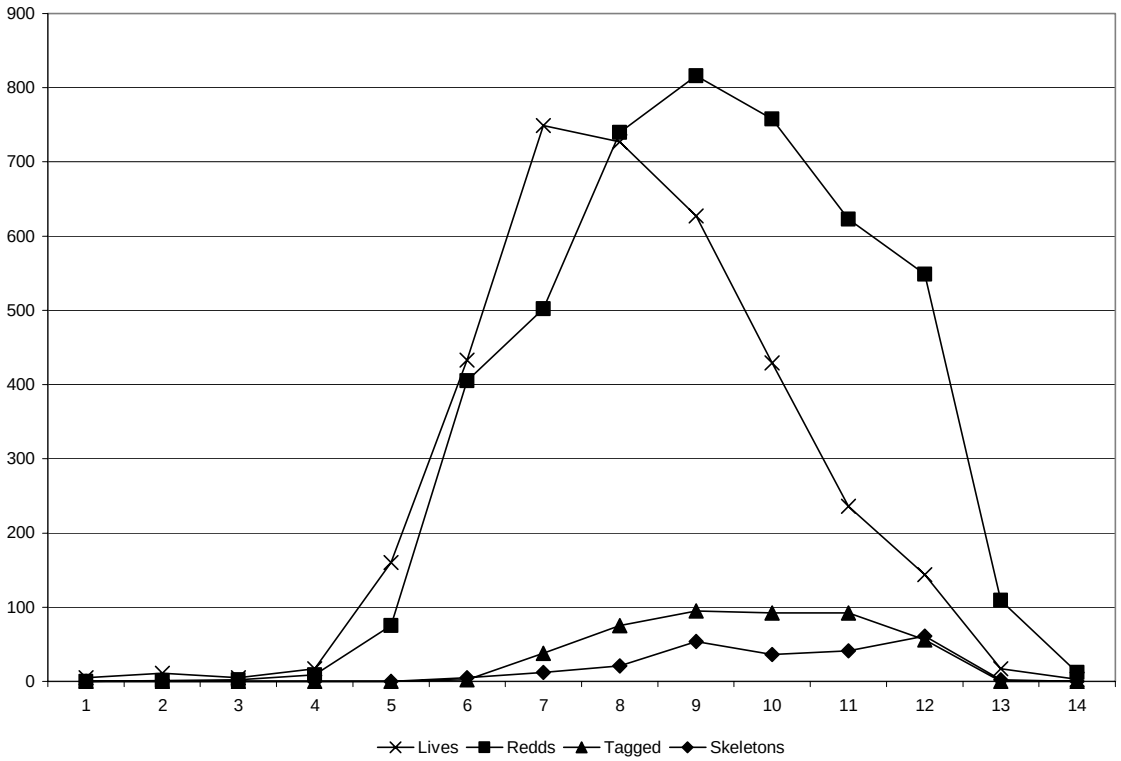

Figure 7. Maximum number of live fish, redds, skeletons, and total tagged carcasses by survey week.

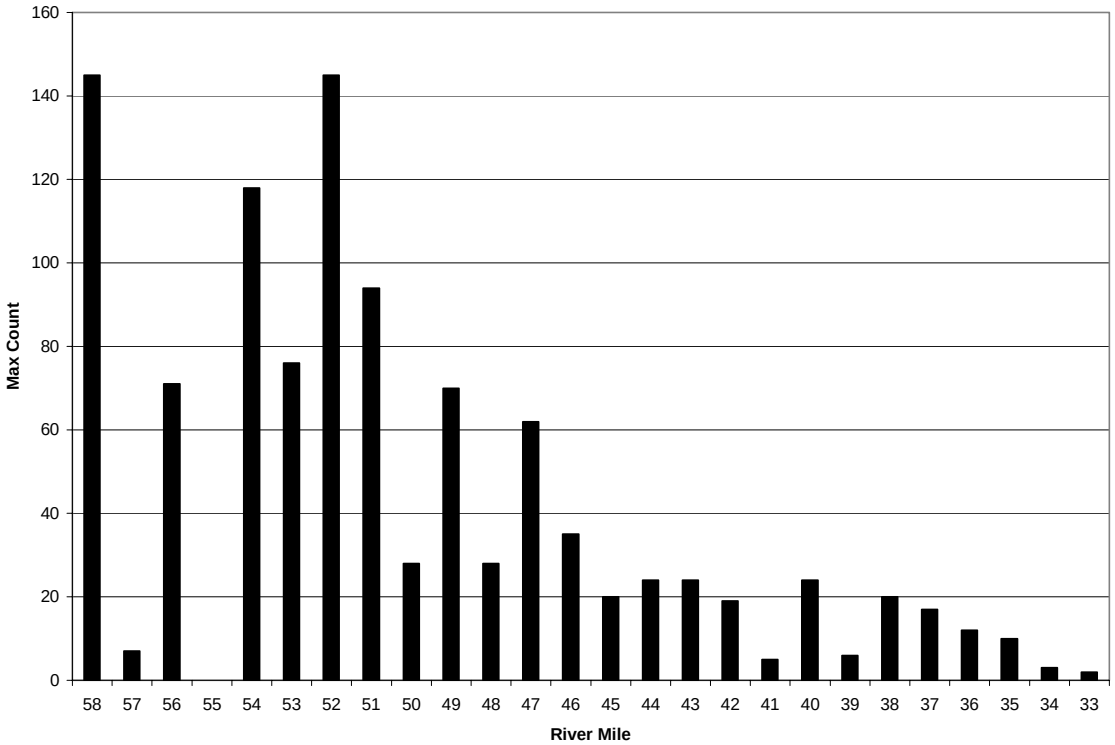

Figure 8. Maximum number of redds observed by river mile.

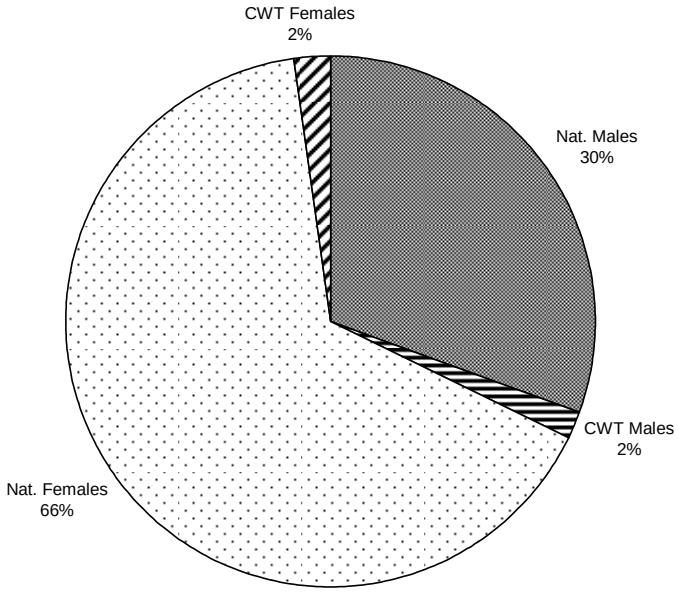

Figure 9. Contribution of male natural, male CWT, female natural, female CWT to the 2005 Stanislaus River escapement.

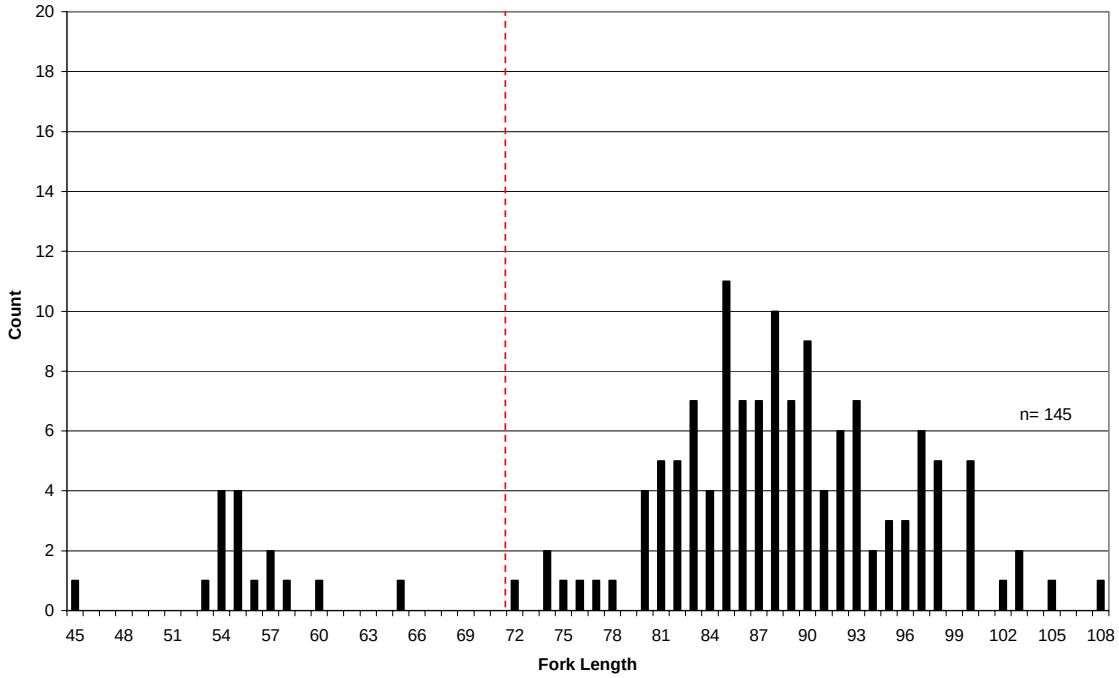

Figure 10. Length frequency histogram of male chinook salmon.

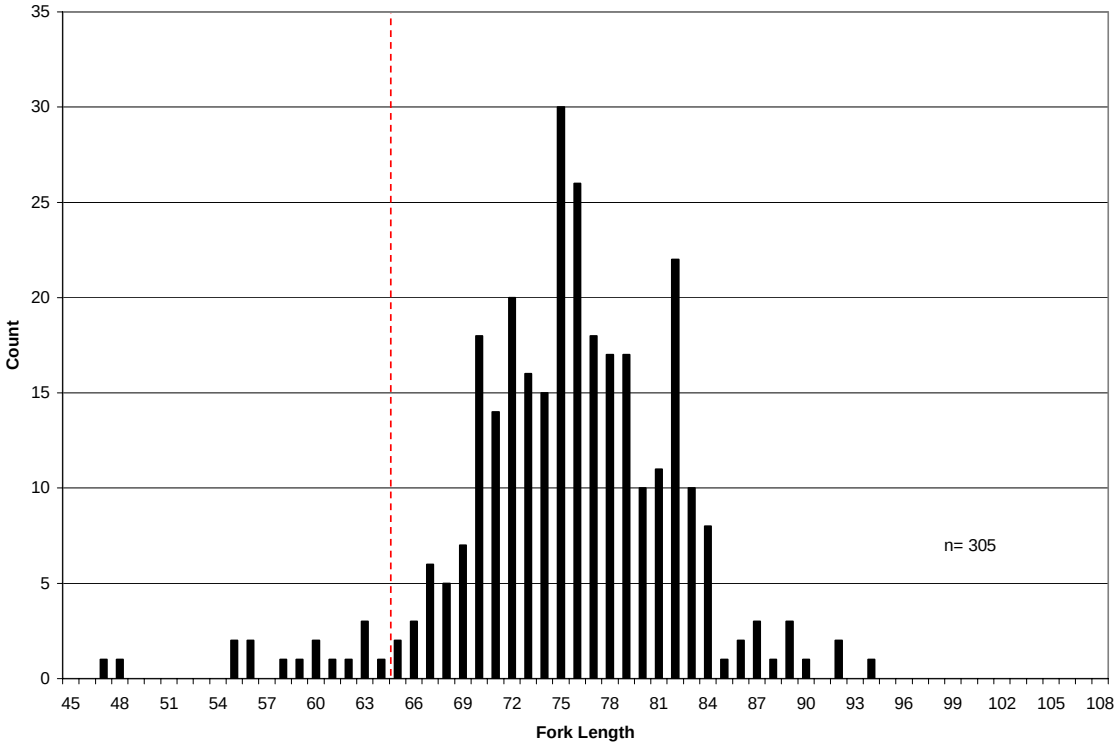

Figure 11. Length frequency histogram of female chinook salmon.

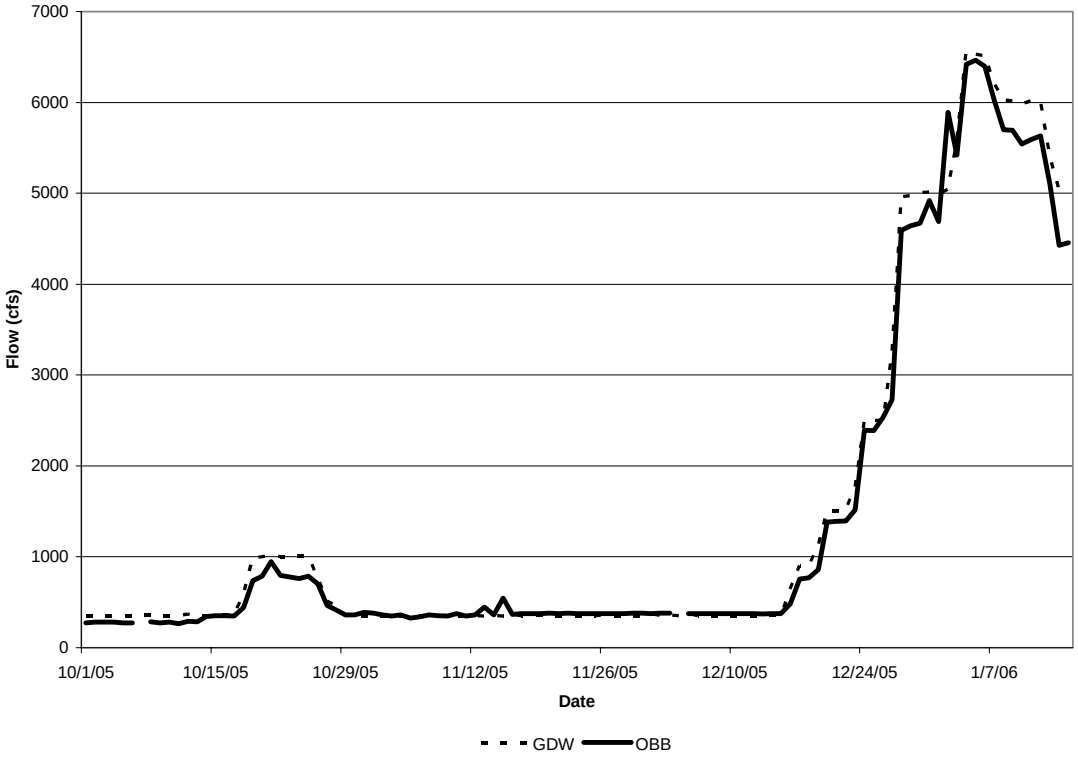

Figure 12. Average daily Stanislaus River flow (cubic feet per second) during the 2005 escapement survey. Preliminary data obtained from the California Data Exchange Center.

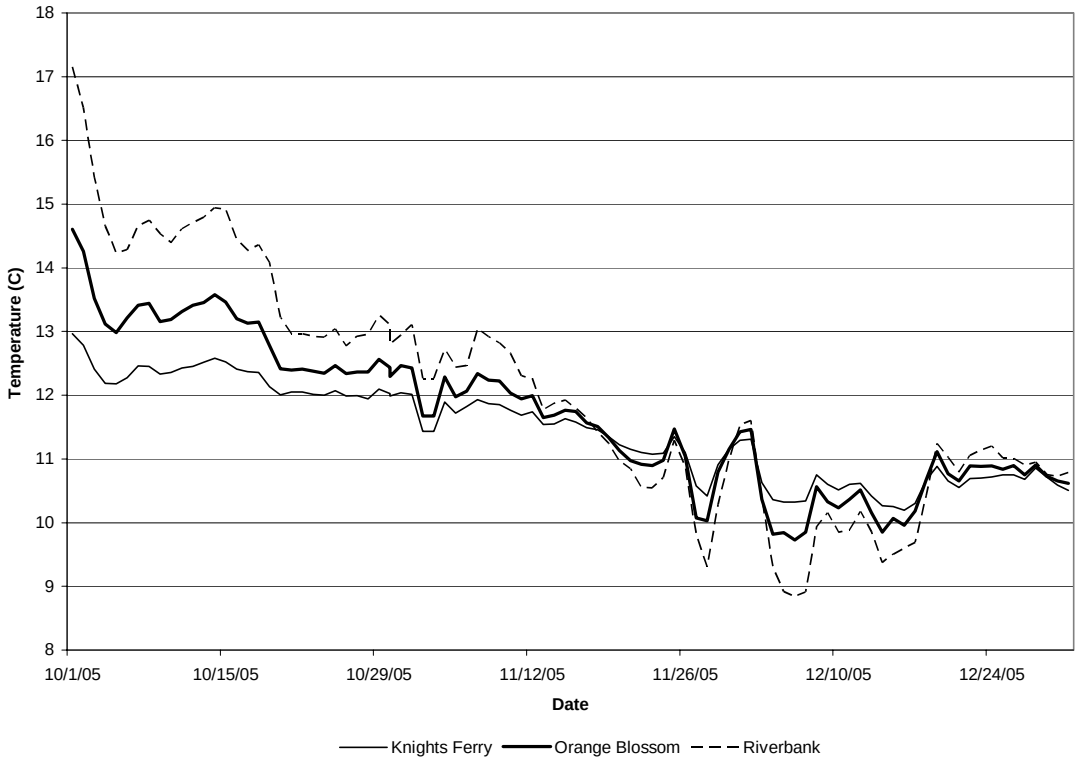

Figure 13. Average daily temperature

Appendix 1. 2005 Stanislaus River coded wire tag collection results

Tag Code	Brood Yr	Release Yr	Hatchery Location	Release Location	# Recovered
06-02-82	2002	2003	Merced R.	Durham Ferry	1
06-02-83	2002	2003	Merced R.	Durham Ferry	1
06-27-23	2001	2002	Mokelumne R.	Jersey Point	1
06-27-44	2002	2003	Merced R.	Jersey Point	2
06-27-51	2002	2003	Merced R.	Jersey Point	1
06-44-69	2001	2002	Merced R.	Old Fisherman's Club	1
06-44-71	2001	2002	Merced R.	Durham Ferry	1
06-45-69	2002	2003	Merced R.	Knights Ferry	2
06-45-70	2002	2003	Merced R.	Two Rivers	1
06-46-70	2003	2004	Merced R.	Mossdale	1
06-49-28	2001	2002	Mokelumne R.	Sherman Island	1
No Tag					5

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